

Hospital Pediatrics®

AN OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Pediatric Intern Clinical Exposure During the COVID-19 Pandemic

Alexandra T. Geanacopoulos, Kathryn M. Sundheim, Kimberly F. Greco,
Kenneth A. Michelson, Chase R. Parsons, Jonathan D. Hron, Ariel S. Winn

DOI: 10.1542/hpeds.2021-005899

Journal: *Hospital Pediatrics*

Article Type: Brief Report

Citation: Geanacopoulos AT, et al. Pediatric Intern Clinical Exposure During the COVID-19 Pandemic. *Hosp Pediatr*. 2021; doi: 10.1542/hpeds.2021-005899

This is a prepublication version of an article that has undergone peer review and been accepted for publication but is not the final version of record. This paper may be cited using the DOI and date of access. This paper may contain information that has errors in facts, figures, and statements, and will be corrected in the final published version. The journal is providing an early version of this article to expedite access to this information. The American Academy of Pediatrics, the editors, and authors are not responsible for inaccurate information and data described in this version.

Pediatric Intern Clinical Exposure During the COVID-19 Pandemic

Alexandra T. Geanacopoulos, M.D.¹, Kathryn M. Sundheim, M.D.¹, Kimberly F. Greco, M.P.H.², Kenneth A. Michelson, M.D., M.P.H.^{1,3}, Chase R. Parsons, D.O., M.B.I.⁴, Jonathan D. Hron, M.D.⁴, Ariel S. Winn, M.D.⁴

Affiliations: ¹Department of Pediatrics, Boston Children's Hospital, Boston, MA, ²Institutional Centers for Clinical and Translational Research, Boston Children's Hospital, Boston, MA, ³Division of Emergency Medicine, Boston Children's Hospital, Boston, MA, ⁴Division of General Pediatrics, Department of Pediatrics, Boston Children's Hospital, Boston, MA

Address correspondence: Alexandra Geanacopoulos, Department of Pediatrics, Boston Children's Hospital, 300 Longwood Avenue, Boston MA, 02115; alexandra.geanacopoulos@childrens.harvard.edu, phone: 617.355.6000

Running Title: Pediatric Intern Clinical Exposure During COVID-19

Funding Source: Dr. Kenneth Michelson received funding through award 1K08HS026503 from the Agency for Healthcare Research and Quality (AHRQ). The funder/sponsor did not participate in the work.

Financial Disclosure: The authors have no financial relationships relevant to this article to disclose.

Conflicts of Interest: The authors have no conflicts of interest relevant to this article to disclose.

Abbreviations: CCSR (Clinical Classifications Software Refined), ED (emergency department), ICD-10-CM (International Classification of Diseases, Tenth Revision, Clinical Modification), ICU (intensive care unit), PHM (pediatric hospital medicine)

Keywords: graduate medical education, emergency pediatrics, general pediatrics, COVID-19 pandemic

Abstract Word Count: 224

Manuscript Word Count: 1,496

Contributors' Statement:

Drs. Geanacopoulos and Winn conceptualized and designed the study, collected data, carried out the data analyses, drafted the initial manuscript, and reviewed and revised the manuscript.

Dr. Sundheim contributed to the design of the study, drafted the initial manuscript, and reviewed and revised the manuscript.

Ms. Greco contributed to the design of the study, carried out the data analyses, and reviewed and revised the manuscript.

Dr. Michelson contributed to the design of the study, contributed to the data analysis, and reviewed and revised the manuscript.

Dr. Parsons contributed to the design of the study and reviewed and revised the manuscript.

Dr. Hron contributed to the design of the study, collected data, carried out the data analyses, and reviewed and revised the manuscript.

Drs. Geanacopoulos and Winn had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Acknowledgements

We would like to acknowledge Madeline VanUmmersen and Jessica Angerman for their assistance in extracting data on pediatric intern schedules.

Abstract

Background/Objectives: Pediatric healthcare encounters declined during the COVID-19 pandemic, and pediatric residency programs have adapted trainee schedules to meet the needs of this changing clinical environment. We sought to evaluate the impact of the pandemic on pediatric interns' clinical exposure.

Methods: In this retrospective cohort study, we quantified patient exposure among pediatric interns from a single large pediatric residency program at a freestanding children's hospital. Patient encounters and shifts per pediatric intern in the inpatient and emergency department (ED) settings were evaluated during the COVID-19 pandemic, March-June 2020, as compared to these three months in 2019. Patient encounters by diagnosis were also evaluated.

Results: The median number of patient encounters per intern per two-week block declined on the pediatric hospital medicine (PHM) service (37.5 vs 27.0, $p<0.001$) and intensive care step-down unit (29.0 vs. 18.8, $p=0.004$) during the pandemic. No significant difference in ED encounters was observed (63.0 vs. 40.5, $p=0.06$). The median number of shifts worked per intern per two-week block also decreased on the PHM service (10.5 vs. 9.5, $p<0.001$). Across all settings, there were more encounters for screening for infectious disease and fewer encounters for respiratory illnesses.

Conclusions: Pediatric interns at the onset of the COVID-19 pandemic were exposed to fewer patients and had reduced clinical schedules. Careful consideration is needed to track and supplement missed clinical experiences during the pandemic.

Introduction

In the setting of social distancing measures during the coronavirus 2019 (COVID-19) pandemic, pediatric hospitals have reported lower pediatric patient volumes across hospital settings.¹⁻⁵ In response to these changes and in an effort to minimize resident exposure, residency programs have altered resident schedules.^{6,7} We sought to evaluate the impact of the COVID-19 pandemic on pediatric interns' exposure to different types and care settings of pediatric diseases, at the onset of the pandemic and amidst the initial surge. We hypothesized that pediatric interns evaluated fewer patients and that these patients had a different spectrum of disease during the COVID-19 pandemic.

Methods

Study Design and Setting

We performed a retrospective cohort study at a freestanding children's hospital of patients cared for by pediatric interns from a single large pediatric residency program. The study hospital's institutional review board approved the study protocol. At the study hospital, interns rotate through the pediatric hospital medicine service (PHM), an intensive care unit (ICU) step-down service, and the emergency department (ED).⁸ These rotations were selected, as they represent common settings through which pediatric residents across the country typically rotate during the intern year. At the onset of the pandemic, in response to perceived reductions in patient volumes and in an effort to minimize infectious risks, our residency program reduced intern clinical schedules. Shift length was not adjusted during the study period. Patient encounters from other affiliating hospitals where interns also rotate were excluded from analysis given storage in different data warehouses that were not available for data extraction.

Patient Population

We queried the enterprise data warehouse at the study institution and identified patients and the pediatric interns who cared for them during the initial peak of the COVID-19 pandemic (March through June 2020) at the study location as compared to March through June 2019. We included patient encounters in the hospital's ED and inpatient setting including the PHM and ICU step-down services. We included patient encounters where an intern either wrote a note in the ED or wrote a note or placed an order in the inpatient setting. Patients on whom interns wrote orders during daily rounds were counted towards patient exposures with the rationale that interns had the opportunity to learn about these patients. For the inpatient setting, a patient encounter may span multiple days so documentation of a note or order on any day was counted as a single patient encounter exposure.

Study Outcomes

We evaluated the number of patient encounters per pediatric intern per two-week block and per shift and the number of shifts per intern per two-week block. Shifts worked were determined using the residency program's online scheduling platform. International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM), codes were collected for all patient encounters. We converted these ICD-10-CM codes into a smaller group of clinically meaningful categories using the Clinical Classifications Software Refined (CCSR) database, developed by the Agency for Healthcare Research and Quality.⁹ We then evaluated the number of patient encounters with a given CCSR code seen per pediatric intern per two-week block in the inpatient and ED settings.

Data Analyses

Categorical descriptive statistics were used to summarize patient and encounter characteristics. Continuous variables were summarized by median and interquartile range. Wilcoxon rank sum tests (for continuous data) and 2-sample Poisson tests (for incidence data, such as encounters per intern-block) were performed to compare differences in primary outcomes between 2019 and 2020.

Results

Median (interquartile range) patient encounters per intern per two-week block declined by 28.0% on the PHM service (37.5 (36.0-43.0) vs 27.0 (22.0-36.0), $p < 0.001$) and by 35.5% on the ICU step-down service (29.0 (21.5-35.0) vs. 18.75 (14.0-22.0), $p = 0.004$) during the pandemic as compared to the year prior (**Figure 1A**). Median patient encounters per intern per two-week block were not significantly different before versus during the pandemic in the ED (63.0 (57.0-71.0) vs. 40.5 (32.0-57.0), $p = 0.06$; **Figure 1A**). The median number of patient encounters per intern per shift declined in the ED (6.7 (6.3-7.1) vs. 4.5 (3.2-5.7), $p = 0.04$) and in the ICU step-down service (2.7 (2.0-3.5) vs. 1.8 (1.6-2.2), $p = 0.03$), while encounters per shift were not significantly different for interns on the PHM service during the pandemic (3.5 (3.3-4.2) vs. 3.3 (2.7-3.9), $p = 0.13$; **Figure 1B**). Importantly, the number of shifts worked per intern per two-week block was significantly less during the pandemic on the PHM service, while there was no significant difference observed in the ED and the ICU step-down service (**Figure 1C**).

The mean number of patient encounters per pediatric intern with a given diagnosis is compared before versus during the pandemic in **Figure 2A-C**. In the inpatient and ED settings, there was an increase in mean encounters per intern per two-week block for the CCSR code, “exposure,

encounters, screening or contact with infectious disease”. On the PHM service, the average intern saw 80% fewer patients with “acute bronchitis” during the pandemic (**Figure 2B**), and reductions in encounters for respiratory illnesses were observed across all three settings. In the ED, there was also a 55% decrease in mean encounters per intern for abdominal pain (**Figure 2A**).

Discussion

During the COVID-19 pandemic, pediatric interns at a large pediatric residency program were exposed to fewer patients and worked fewer shifts in the inpatient and ED settings. Our findings are supported by several recent studies demonstrating reduced pediatric patient volumes across settings nationwide.^{4,5,10–15} We observed declines in encounters for respiratory illnesses in support of other recent studies documenting similar trends.^{10,11} While there have been few published studies documenting the impact of COVID-19 on resident patient exposure, one study of an emergency medicine residency in Taiwan demonstrated that ED residents saw less than half the typical patient volume.¹⁶ Although our study reflects a single residency program’s experience, early on in the pandemic, declines in pediatric patient census have been documented nationwide. Similarly, residency programs in other specialties have reported on reduced clinical schedules.^{7,17} Therefore, it is likely that pediatric interns across the country saw significantly fewer pediatric patients and worked reduced shifts on pediatric clinical services during the early COVID-19 pandemic.

These changes have heightened concerns among residency program leadership and trainees about whether reduced patient exposure may impact clinical competency.^{7,18} In a study of radiology residents assessing the impact of exposure on performance, residents who interpreted more radiographic films had improved performance as measured by accuracy of their diagnostic

reads.¹⁹ In two other studies evaluating family medicine and internal medicine residents, residents who saw more patients scored higher on in-training exams.^{20,21} Given this association between exposure and competency, it is therefore important for residency programs to consider tracking resident-level patient exposures during the pandemic. It is also important to recognize that concerns about competency may impact intern confidence in medical decision-making, particularly as they gain additional autonomy at the end of intern year. Acknowledging these concerns and addressing gaps in the clinical experience may alleviate this anxiety and provide interns with the tools to feel more confident and comfortable in their decision-making.

Throughout the pandemic, residency programs in specialties across the country have developed innovative strategies to augment resident clinic experience. Radiology and surgical programs have developed simulations to mimic regular work days for residents.^{6,24} Our program developed a virtual work from home option for residents with heightened individual or family health risks.²⁵ While these strategies do not replace in-person clinical interactions, virtual learning and patient care play fundamental roles in advancing resident training while also minimizing infectious risks.

Our study has several important limitations. Our findings represent a single residency program's experience during a 3-month period at the onset of the pandemic and amidst a surge of cases within the community and therefore may not be generalizable to all institutions. However, given documentation of widespread reductions in pediatric patient volumes during the pandemic, pediatric residency programs across the country likely experienced similar trends. We were also unable to assess intern patient exposure during rotations outside the main study hospital which provided important additional training opportunities that were not quantified in this study. Next

steps include evaluating intern's clinical exposure through the 2020-2021 academic year as the pandemic has progressed and also assessing national trends outside of our single institution.

In a large pediatric residency program, the onset of the COVID-19 pandemic was associated with reductions in overall clinical exposure to patients and the breadth of pediatric disease. We identified a disproportionate decrease in patient exposures for respiratory and abdominal symptoms, common complaints that are key complaints for pediatrics residents to gain experience diagnosing and managing. If the COVID-19 pandemic or future pandemics continue to negatively impact pediatric patient volumes, it will be important for residency programs to track intern patient exposures and assess whether reduced volumes impact competency and attainment of professional milestones during training. In addition, identifying reductions in patient exposures by specific setting or disease processes, as we have done in this study, would allow programs to develop targeted interventions through simulation or virtual teaching curricula to supplement the clinical experience.

References

1. Zachariah P, Johnson CL, Halabi KC, et al. Epidemiology, Clinical Features, and Disease Severity in Patients With Coronavirus Disease 2019 (COVID-19) in a Children's Hospital in New York City, New York. *JAMA Pediatr.* 2020;174(10):e202430.
2. Dong Y, Mo X, Hu Y, et al. Epidemiology of COVID-19 Among Children in China. *Pediatrics.* 2020;145(6):e20200702.
3. Tagarro A, Epalza C, Santos M, et al. Screening and Severity of Coronavirus Disease 2019 (COVID-19) in Children in Madrid, Spain [published online ahead of print, 2020 Apr 8]. *JAMA Pediatr.* 2020;e201346.
4. Isba R, Edge R, Jenner R, Broughton E, Francis N, Butler J. Where have all the children gone? Decreases in paediatric emergency department attendances at the start of the COVID-19 pandemic of 2020. *Arch Dis Child.* 2020;105(7):704.
5. Wilder JL, Parsons CR, Growdon AS, Toomey SL, Mansbach JM. Pediatric Hospitalizations During the COVID-19 Pandemic [published online ahead of print, 2020 Nov 3]. *Pediatrics.* 2020;e2020005983.
6. Johnson J, Chung MT, Carron MA, Chan EY, Lin HS, Hotaling J. Novel Changes in Resident Education during a Pandemic: Strategies and Approaches to Maximize Residency Education and Safety. *Int Arch Otorhinolaryngol.* 2020;24(3):e267-e271.
7. Fero KE, Weinberger JM, Lerman S, Bergman J. Perceived Impact of Urologic Surgery Training Program Modifications due to COVID-19 in the United States. *Urology.* 2020;143:62-67.
8. Miller KA, Hillier D, Russ C, Luercio M, Winn AS. Applying Self-Determination Theory to Redesign an Inpatient Care Team. *Acad Pediatr.* 2019;19(3):351-353.
doi:10.1016/j.acap.2018.09.010
9. Healthcare Cost and Utilization Project (HCUP). Clinical Classifications Software Refined (CCSR) for ICD-10-CM Diagnoses." Agency for Healthcare Research and Quality, https://www.hcup-us.ahrq.gov/toolssoftware/ccsr/ccs_refined.jsp. Accessed November 15, 2020.
10. Kenyon CC, Hill DA, Henrickson SE, Bryant-Stephens TC, Zorc JJ. Initial effects of the COVID-19 pandemic on pediatric asthma emergency department utilization. *J Allergy Clin Immunol Pract.* 2020;8(8):2774-2776.e1.
11. Hatoun J, Correa ET, Donahue SMA, Vernacchio L. Social Distancing for COVID-19 and Diagnoses of Other Infectious Diseases in Children. *Pediatrics.* 2020 Sep 2 [accessed 2020 Sep 10];e2020006460.
12. Bram JT, Johnson MA, Magee LC, et al. Where Have All the Fractures Gone? The Epidemiology of Pediatric Fractures During the COVID-19 Pandemic. *J Pediatr Orthop.* 2020;40(8):373-379.

13. Chaiyachati BH, Agawu A, Zorc JJ, Balamuth F. Trends in Pediatric Emergency Department Utilization after Institution of Coronavirus Disease-19 Mandatory Social Distancing [published online ahead of print, 2020 Jul 20]. *J Pediatr*. 2020;226:274-277.e1.
14. McDonnell T, Nicholson E, Conlon C, et al. Assessing the Impact of COVID-19 Public Health Stages on Paediatric Emergency Attendance. *Int J Environ Res Public Health*. 2020;17(18):6719. Published 2020 Sep 15.
15. Ferrero F, Ossorio MF, Torres FA, Debaisi G. Impact of the COVID-19 pandemic in the paediatric emergency department attendances in Argentina [published online ahead of print, 2020 Jun 18]. *Arch Dis Child*. 2020;archdischild-2020-319833.
16. Lo HY, Lin SC, Chaou CH, Chang YC, Ng CJ, Chen SY. What is the impact of the COVID-19 pandemic on emergency medicine residency training: an observational study. *BMC Med Educ*. 2020;20(1):348. Published 2020 Oct 7.
17. Chick RC, Clifton GT, Peace KM, et al. Using Technology to Maintain the Education of Residents During the COVID-19 Pandemic. *J Surg Educ*. 2020;77(4):729-732.
18. Oshiro KT, Turner ME, Torres AJ, Crystal MA, Vincent JA, Barry OM. Non-Elective Pediatric Cardiac Catheterization During COVID-19 Pandemic: A New York Center Experience. *J Invasive Cardiol*. 2020;32(7):E178-E181.
19. Agarwal V, Bump GM, Heller MT, et al. Resident Case Volume Correlates with Clinical Performance: Finding the Sweet Spot. *Acad Radiol*. 2019;26(1):136-140.
20. Iglar K, Murdoch S, Meaney C, Krueger P. Does clinical exposure matter? Pilot assessment of patient visits in an urban family medicine residency program. *Can Fam Physician*. 2018;64(1):e42-e48.
21. Mizuno A, Tsugawa Y, Shimizu T, Nishizaki Y, Okubo T, Tanoue Y, Konishi R, Shiojiri T, Tokuda Y. The impact of the hospital volume on the performance of residents on the general medicine in-training examination: A multicenter study in Japan. *Internal Medicine*. 2016 [accessed 2020 Sep 30];55(12):1553–1558. <https://pubmed.ncbi.nlm.nih.gov/27301504/>. doi:10.2169/internalmedicine.55.6293
22. Kwan C, Pusic M, Pecaric M, Weerdenburg K, Tessaro M, Boutis K. The Variable Journey in Learning to Interpret Pediatric Point-of-care Ultrasound Images: A Multicenter Prospective Cohort Study. *AEM Educ Train*. 2019;4(2):111-122. Published 2019 Jul 30.
23. Lee MS, Pusic M, Carrière B, Dixon A, Stimec J, Boutis K. Building Emergency Medicine Trainee Competency in Pediatric Musculoskeletal Radiograph Interpretation: A Multicenter Prospective Cohort Study. *AEM Educ Train*. 2019;3(3):269-279. Published 2019 Mar 12.
24. Recht MP, Fefferman NR, Bittman ME, et al. Preserving Radiology Resident Education During the COVID-19 Pandemic: The Simulated Daily Readout. *Acad Radiol*. 2020;27(8):1154-1161.
25. Luercio M, Ward VL, Sectish TC, Mateo CM, Michelson CD. One Size Does Not Fit All:

Prepublication Release

Implementation of an Equitable and Inclusive Strategic Response to Address Needs of Pediatric Resident Physicians during the COVID-19 Crisis [published online ahead of print, 2020 Oct 14]. *J Pediatr.* 2020;S0022-3476(20)31290-7.

Figure Legends

Figure 1: Box and whisker plot of (A) patient encounters per intern per two-week block, (B) patient encounters per intern per shift, and (C) shifts worked per intern per two-week block in the emergency department (ED), pediatric hospital medicine (PHM), and intensive care unit (ICU) step-down settings before vs. during the COVID-19 pandemic.

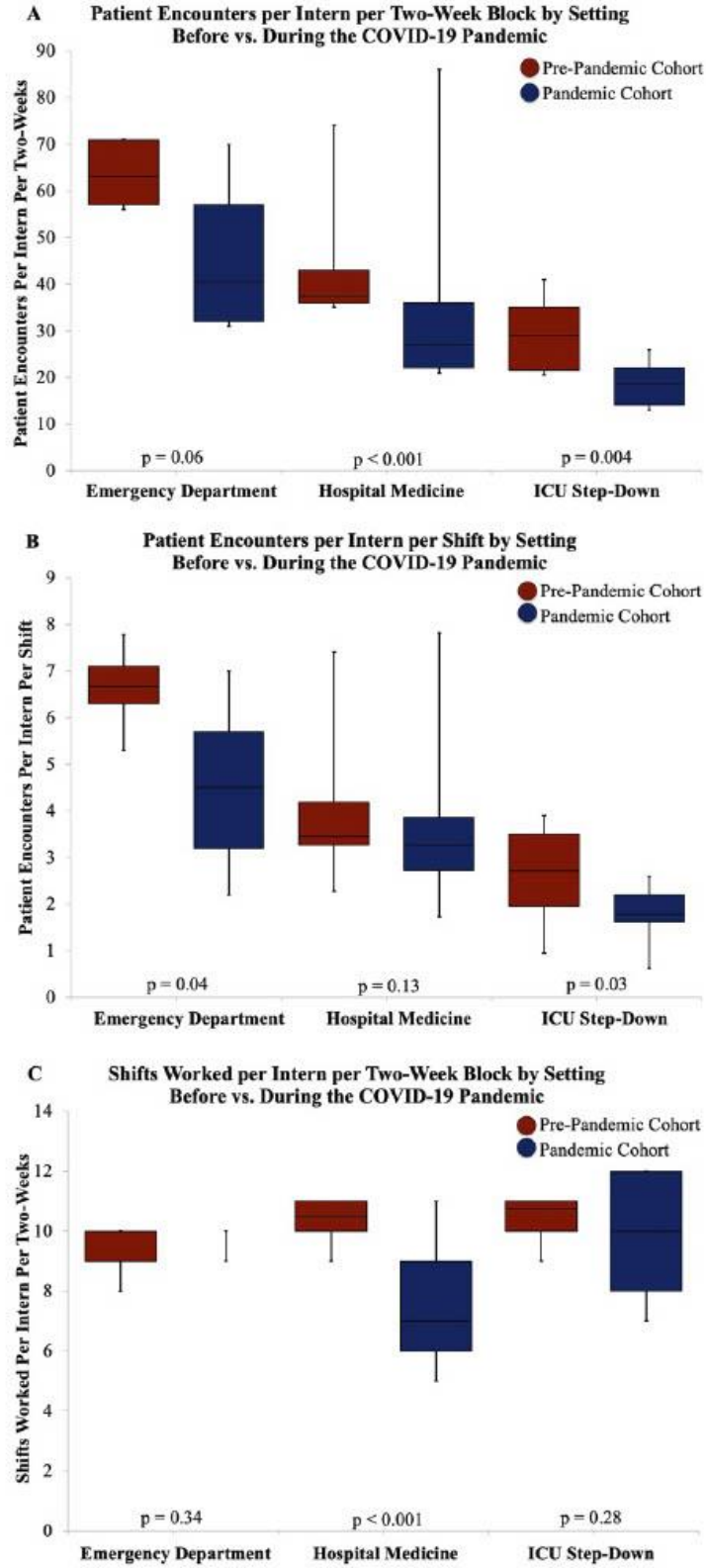
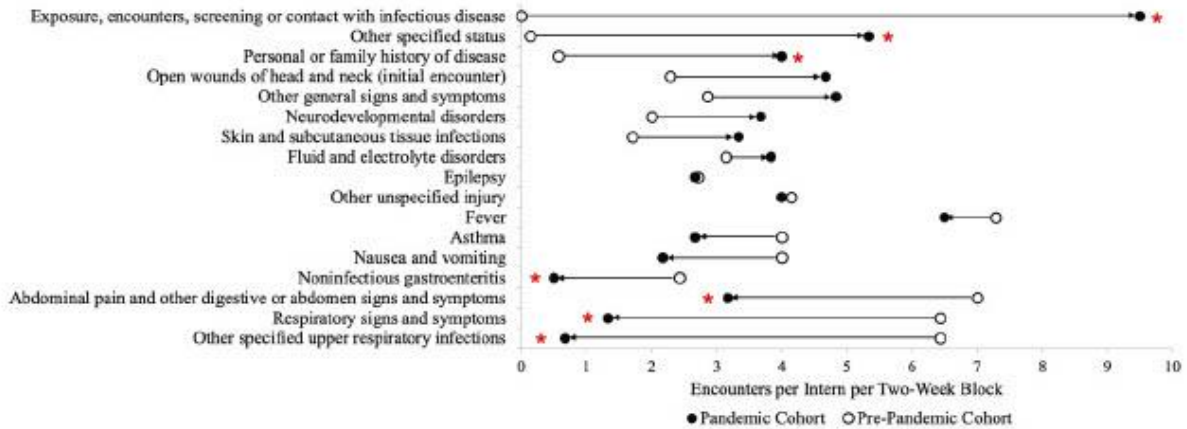
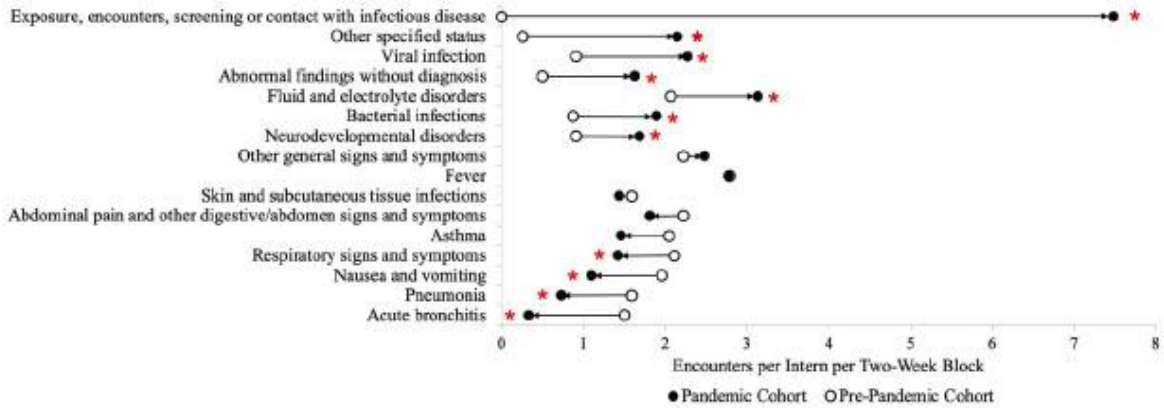


Figure 2: Encounters associated with common CCSR codes before vs. during the COVID-19 pandemic for the (A) emergency department (ED), (B) pediatric hospital medicine (PHM), and (C) intensive care unit (ICU) step-down settings. Values reported as mean encounters by CCSR code per intern per two-week block. Common CCSR codes were identified by the top 10 CCSR codes by setting for both the pre-pandemic and pandemic cohorts. *Indicates statistically significant difference between the pre-pandemic and pandemic cohorts ($p < 0.05$).

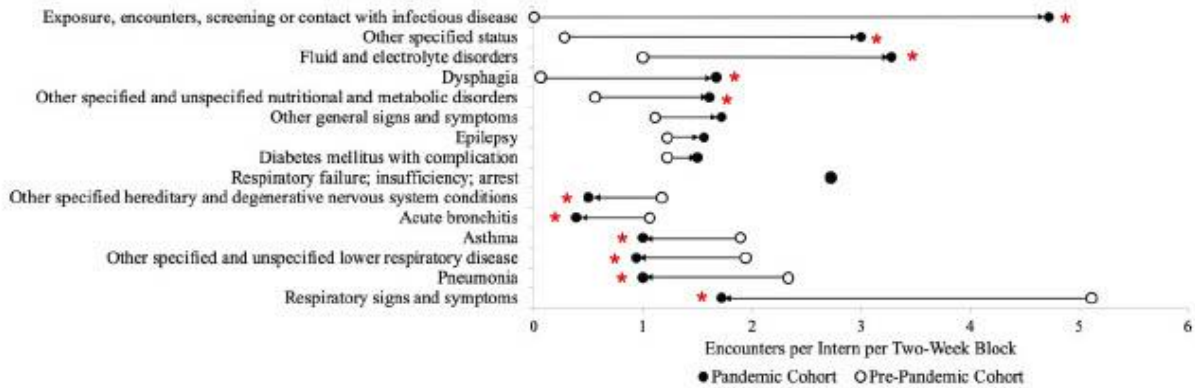
A Emergency Department Mean Encounters by CCSR Code per Intern per Two-Week Block Before vs. During COVID-19 Pandemic



B Hospital Medicine Mean Encounters by CCSR Code per Intern per Two-Week Block Before vs. During COVID-19 Pandemic



C ICU Step-Down Mean Encounters by CCSR Code per Intern per Two-Week Block Before vs. During COVID-19 Pandemic



Pediatric Intern Clinical Exposure During the COVID-19 Pandemic

Alexandra T. Geanacopoulos, Kathryn M. Sundheim, Kimberly F. Greco, Kenneth A. Michelson, Chase R. Parsons, Jonathan D. Hron and Ariel S. Winn
Hospital Pediatrics originally published online April 16, 2021;

Updated Information & Services	including high resolution figures, can be found at: http://hosppeds.aappublications.org/content/early/2021/04/15/hped.2021-005899.citation
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): Continuity of Care Transition & Discharge Planning http://www.hosppeds.aappublications.org/cgi/collection/continuity_of_care_transition_-_discharge_planning_sub Patient Education/Patient Safety/Public Education http://www.hosppeds.aappublications.org/cgi/collection/patient_education:patient_safety:public_education_sub System-Based Practice http://www.hosppeds.aappublications.org/cgi/collection/system-based_practice_sub
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://www.hosppeds.aappublications.org/site/misc/Permissions.xhtml
Reprints	Information about ordering reprints can be found online: http://www.hosppeds.aappublications.org/site/misc/reprints.xhtml

Hospital Pediatrics®

AN OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Pediatric Intern Clinical Exposure During the COVID-19 Pandemic

Alexandra T. Geanacopoulos, Kathryn M. Sundheim, Kimberly F. Greco, Kenneth A. Michelson, Chase R. Parsons, Jonathan D. Hron and Ariel S. Winn

Hospital Pediatrics originally published online April 16, 2021;

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://hosppeds.aappublications.org/content/early/2021/04/15/hped.2021-005899.citation>

Hospital Pediatrics is an official journal of the American Academy of Pediatrics. Hospital Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 345 Park Avenue, Itasca, Illinois, 60143. Copyright © 2021 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

